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Carcass yield and meat quality of pekin duck (*Anas platyrhynchos* F) fed with *Moringa oleifera* leaf meal as soybean oil meal substitute under mixed orchard farming system

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Abstract

A total of 150 F_1 growing Pekin ducks were randomly distributed into 15 ranged pens under mixed orchard equally representing 5 dietary treatments to evaluate the growth performance, carcass yield, hematological profile and return above feed and bird costs of ducks fed different levels of *Moringa oleifera* leaf meal (MOLM) as soybean oil meal (SOM) substitute. The study was undertaken from February 6 to March 5, 2016 at Centro 02 Sanchez Mira, Cagayan, Philippines. The treatments were: Treatment T_0 (control) 100% SOM as protein source, T_1- 25% MOLM substitution of SOM, T_2- 50% MOLM substitution, T_3- 75% MOLM substitution, T_4- 100% MOLM. The study was done in CRD with three replications per treatment. Finding of the study showed that full replacement of MOLM to SOM has no significant effect on the growth and carcass yield parameters of pekin duck. Hence, the carcass quality of pekin ducks fed with different levels of *Moringa oleifera* leaf meal as supplements, i.e., from 25%- 100% substitution of MOLM did not differ significantly in terms of moisture percentage, crude protein(%) and crude fat analysis (%) in both thigh and breast.

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Introduction

In commercial poultry production system, profit can be maximized by minimizing feed cost which accounts the major cost of production. In the Philippines, the major sources of protein for poultry production are Fishmeal (FM) and Soybean Meal (SOM). However, these are imported and becoming more scarce, expensive and used extensively by other livestock and humans. Prices of these conventional protein sources have soared so high in recent times that it is becoming uneconomical to use them in poultry feeds.

Nutrition accounts for 60-70% of the total production cost in modern poultry production systems. Further, feeding has a great effect in poultry growth, egg production and meat quality. This situation has created a need to look for cheap, locally available and less competitive substitutes to some ingredients of poultry feeds and in particular, sources of protein. There is continued scarcity and consequent high prices of conventional protein (soyabeans) and energy sources and this hinders poultry production.

There is a need therefore, to look for locally available and cheap sources of feed ingredients. One possible source of cheap protein is the leaf meal of tropical legumes. Many studies have been conducted using various sources of leaf meal proteins for broilers (Iheukwumere *et al*., 2008; Wude and Berhan, 2009; Onyimonyi *et al*., 2009). Leaf meals do not only serve as source of protein but also provides some necessary vitamins, minerals and oxycarotenoids (D'Mello *et al*., 1987; Opara, 1996). One plant that can serve as source of leaf meal in the diet of poultry is *Moringa olifera* tree (Kakengi *et al*., 2007; Olugbemi *etal*., 2010b). *Moringa oleifera* leaves are packed with nutrients important both for humans and animals. A crude protein percentage of 25-27% is suggestive that the leaves are a good source of protein for livestock. Moringa tree is indigenous to many provinces in the Philippines. This tree thrives well in Sanchez Mira, the site of this study because of its being a coastal area with sandy loam and clay loam types of soil. Moringa is well known for its multipurpose attributes, wide adaptability and ease of establishment.

The tree is fast growing and high yielding, initial trial in Nicaragua have shown a high biomass production of up to 120 tonnes dry matter/ha/year in 8 cuttings after planting one million seeds/hectare (Makkar and Becker, 1997). The tree bears for 30-40 years. The drought tolerant nature of the tree makes it particularly suited to those marginal areas where the cost associated with cultivation and harvesting of other commercial crops like soyabeans is high. The tree is resistant to most pests and diseases, thus making it a cheap source of feed for animals.

Moringa tree is drought tolerant, it is resistant to most diseases and pests, it has a high biomass yield per hectare, it can grow well in marginal areas and it has a high protein value which can support livestock production. All these facts make it a cheap feed source compared to soyabeans, which is a cash crop and it is expensive to produce by the small-scale farmer in marginal areas. Under such conditions, *Moringa oleifera* becomes the crop of choice to explore in livestock production.

In poultry production, the raising of chickens and other species organically by free range or pasture management is now becoming popular because of its higher demand. Health conscious consumers prefer organically grown poultry than commercial broilers because of its satisfying flavor and aroma. Recent researches revealed substantial increases in nutritional value of pastured poultry, particularly in Omega-3 Fatty Acids and Vitamin A, and a significant decrease in total fat thus becoming better food to eat (Lee, 2001). In the Philippines, the main sources of protein for poultry production are fishmeal and soybean oil meal. However, these are imported and becoming more scarce, expensive and used extensively by other livestock and humans. Prices of these conventional protein sources have soared so high in recent times that it is becoming uneconomical to use them in poultry feeds. There is a need therefore, to look for non-conventional, locally available and cheap sources of protein for poultry production. One possible source of cheap protein is the leaf meal of tropical legumes which are abundant in the Philippines.

One plant that can serve as source of leaf meal in the diet of poultry is *Moringa oleifera*. It leaves are packed with nutrients important both for humans and animals. A crude protein percentage of 25- 27% is suggestive that the leaves are a good source of protein for livestock.

With these, *Moringa oleifera* leaf meal must be verified if what levels of its inclusion in the diet could significantly affect the carcass yield, and meat quality of pekin ducks. This study will benefit poultry raisers especially duck growers because they would be given options to lower down their production cost through the use of alternative protein source for feeds. Likewise, the consumers because of healthy, better tasting and possibly cheaper poultry meat from duck produced in the range and fed with nutritious *Moringa oleifera*.

The study generally aimed to evaluate the carcass yield and meat quality of pekin ducks under mixed orchard given pelletized formulated rations with different levels of *Moringa oleifera* leaf meal (MOLM) as substitute for soybean meal (SBM).

Materials and methods

The Experimental Animals

One hundred fifty 14-day old pekin ducklings, meat type were randomly selected and distributed to treated and control groups with 10 animals per group. The ducks are placed in individual open-ranged pens under mixed orchard farming system. To ensure uniformity of stocks, the experimental birds were purchased from Superior F1 Genetic Enterprise owned by free-range poultry specialist Dr. Erwin J. S. Cruz.

Experimental Treatments and Design

A completely randomized design (CRD) was used with 5 dietary treatments (control, and 4 levels of MOLM substitute diets) with three replications per treatment. For each of the replication, there were 10 randomly selected pekin ducks in each of the 15 pens (total of 150 heads). The birds were fed according to the type of experimental diet assigned to each treatment as follows: To Control - 100% SOM as protein source, T 1–25% MOLM substitution of SOM, T2 – 50% MOM substitution of SOM, T3 – 75% MOLM substitution of SOM and T4 – 100% MOLM as protein source.

Statistical Analysis

Statistical analyses were performed, pre-processing live weights, feed consumption, feed conversion, feed conversion efficiency, dressing percentage, chilled carcass weight, breast, thigh, wing, and drum weights; as well as moisture, protein, and fat values for breast and thigh meat. Carcass yield values were evaluated on a weight basis and as a percentage of pre-processing live or chilled carcass weight as appropriate. Statistical analysis (ANOVA) in Completely Randomized design (CRD) was carried out using computer programs e.g. Statistical Tool for Agricultural Research (STAR). The statistical model included effects of treatments, with the experimental unit being the pen. The mean values that were obtained for the pekin duck fed soybean meal as protein source were compared with those fed malungay leaf as protein source diets at the 5% and 1% level of significance using a protected Fisher's least significant difference test (Fisher, 1949).After two weeks of brooding, 10 day old ducklings were randomly distributed to each rearing house/range area. The allocation of the rations was based on the randomized procedure for CRD.

Experimental Area

The experimental animals were ranged under mixed orchard to partly cover the birds from direct sunlight. The area is an ideal site to raise ranged poultry with coconut as the predominant crop, and other trees such as citrus, gmelina, molave, and mahogany. In addition, under the trees are mixture of native grasses and edible weeds, which are good sources of other nutrients for the birds' growth. The appearance and vegetation of the area is uniform.

Brooding & Rearing Area

An existing house was used for the brooding of ducklings for two weeks. A rearing house with a dimension of 1.0m x 1.5m was constructed for each replication to accommodate 10 heads during the experimental period. The structure was built using wood, bamboo and G.I sheet.

Five inches deep rice hull was provided as litter materials. The rearing area served as shed for the birds during night time and inclement weather.

Preparation of the Experimental Area

The range area is four (4) sq m. per bird. A total of 150 heads of ducks was used for the whole duration of the study. The total area used in this study is 600 square meters which was divided into 15 experimental units to come up with 40 square meters per experimental unit. The experimental area was enclosed and divided with poultry nets to prevent transfer of birds to other groups and likewise protect them from predators.

Sources of Feed Ingredients

The ingredients such as SOM, fish meal, coco oil, molasses, DL-methionine, L-Lysine, diCal.Phos, and vitamin premix were bought at Decena Feed Mill in Enrile, Cagayan. Salt, copra meal, and yellow corn were purchased locally.*Moringa oleifera* leaves were collected from the locality, sun dried to 13-14% and milled to form into MOLM.

Physical Appearance

The pekin ducks used in the study are F1 meat-type, fast growing that are procured from F1 Superior F1 Genetic Enterprise owned by free-range poultry specialist Dr. Erwin J. S. Cruz. This strain of duck is usually raised in confinement. During the experimental period, they grew fast even when in range and achieved an average of 2.4 kilograms in five weeks. Ducks fed with MOLM exhibited faster growth than the control group.

Pigmentation

During the study, ducks fed with MOLM have more prominent yellow beak and shank than the ducks fed with full soybean. Likewise, ducks fed with moringa have cleaner and smoother feathers than the control group. Moringa oleifera leaf meal does not only serve as protein source but also provide some necessary vitamins and oxy carotenoids which cause yellow color of broiler skin, shank and egg yolk (www.United caribbean.com. 2003). The yellow pigment is highly visible in the skin of dressed ducks fed with moringa than the control group which exhibited slightly yellow skin.

Generally, there was a pronounced intense yellowish coloration of the beak, legs, carcass cuts, abdominal fat and feathers of broilers that received dietary MOLM than birds that got no MOLM. This presumably may be due to the high content of beta-carotene in MOLM. The yellow color in the body and products of broilers observed in this study is an indication of the efficient absorption and utilization of the pigment xanthophyll present in MOLM. Similarly, Ayssiwede *et al.* (2011) observed that dietary MOLM inclusion to have produced yellow coloration of the skin and abdominal fat of growing indigenous chickens. The birds were experiencing yellow colouration of body parts which was mainly attributed to the presence of xanthophylls and carotenoid pigments in MOLM as in other tree and shrub leaf meals as outlined by Austic and Neishen (1990).

Livability

The ducks stayed on range from day 15 to day 37 under mixed orchard. There was no mortality observed during the experimental period even though there was intermittent rain and the temperature was very cold. This means that the feeds given and the range system of raising them have no adverse effect on their livability. However, it was observed that in the control group, feed consumption decreased on the 1st to 2nd day of the 2nd week of rearing, but recovered on the 3rd day of that week. In the treatment groups, there were no cases of any sickness even there was an adverse conditions experienced by the ducks in their range environment. This implies that the birds were easily acclimatized to their environment after they were transferred from the brooder to the range area.

Feeding and Grazing Behavior

Feeds are given at 6:00 in the morning for all the treatment replications throughout the study period. Refill of feeds was done any time when necessary or if they already consumed their feed allotment for the day. On their first day at the range area, the birds appeared to be very nervous and huddled together around their rearing houses. As the day progress, they tend to adapt their new environment as they started to feed and graze.

Throughout the study period, the birds generally exhibited normal feeding and grazing behavior. They fed and graze in the range alternately during the day and back to the rearing house to roost at night time. Lights were not provided at the rearing houses.

Results and Discussion

Carcass Yield

Processing Live Weight

The live weight of pekin duck fed with different levels of moringa oleifera leaf meal as soybean substitute ranged from 2342.7 grams to 2894 grams. The analysis of variance revealed insignificant effect of the different levels of MOLM as soybean substitute on the live weight of pekin duck.

Dressing Percentage

The dressing percentage with giblets ranged from 64.45 to 72.81 while the dressing percentage without giblets ranged from 51.66 to 58.97. The analysis of variance on this two carcass parameters revealed that there were no significant differences among the treatment means.

Chill Weight

The chill weight of pekin duck ranged from 1441 grams to 1714.7 grams. on the other hand, the chill weight per percent of live weight of pekin duck ranged from 57.88 to 71.83. The analysis of variance on these carcass parameters revealed insignificant differences among treatment means.

Fat Pad Weight

The fat pad weight of pekin duck as affected by different levels of MOLM as soybean substitute ranged from 42.3 to 71.3. on the other hand, the fat pad weight based on the percent live weight of pekin duck as affected by the different levels of MOLM as soy bean substitute ranged from 1.80 to 2.86.

The analysis of variance revealed that there was no significant effect of substituting soybean with MOLM on these two carcass parameters.

Breast, Thigh, and Drum Weights

The breast weight, thigh weight and drum weight based on percent chill weight ranged from 23.62 to 25.41, 7.33 to 10.16, and 10. 33 to 12. 04, respectively.

The same observation was observed on these carcass parameters. The analysis of variance revealed insignificant differences among the treatment means. This means that the different levels of MOLM as soybean substitute did not in any way affect the carcass yield of pekin duck.

Table 1. The live weight and carcass evaluation data of pekin duck fed Different Levels of *Moringa oleifera* Leaf Meal (MOLM) as Soybean substitute under mixed-orchard farming system.

Treatments	Live weight (g/bird)	Dressing Percentage w/ Giblets	Dressing Percentage w/o Giblets	Chill Weight (g/bird)	Chill weight (% of live weight)	Fat Pad weight	Fat Pad weight (% live weight)	Breast Weight (% chill weight)	Thigh weight (% of chill weight)	Drum weight (% of chill weight)
To (SB)	2367.7	64.45	53.45	1483.0	71.83	62.0	2.61	23.62	8.87	11.11
T1	2894.0	69.84	51.66	1714.7	57.99	52.7	1.82	25.41	7.33	10.33
T2	2523.3	71.84	58.97	1545.7	63.99	71.3	2.86	23.68	9.97	11.06
T3	2342.7	72.81	58.68	1441.0	64.48	42.3	1.80	23.79	10.10	12.04
T4	2467.7	70.30	57.54	1460.7	57.88	60.7	2.51	24.03	10.16	11.13
ANOVA Result	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
C.V. (%)	11.92	5.69	10.52	13.34	7.01	4.6	4.8	12.9	12.55	8.66

* = significant at 5% level.

Note: Means with common letters are not significantly different with each other using LSD.

Meat Quality (Thigh and Breast Meat)

The carcass quality of pekin ducks fed with different levels of *Moringa oleifera* leaf meal as supplements, i.e., from 25%- 100% substitution of MOLM did not differ significantly in terms of moisture percentage, crude protein(%) and crude fat analysis (%) in both thigh and breast, respectively except for crude protein analysis in thigh and moisture analysis in thigh.

The moisture contents of breast meat of pekin duck fed with 25% to 100% MOLM as protein source gave

comparable results with pekin ducks fed with 100% SOM as protein source. However, moisture analysis of thigh meat gave significant results. T4 which has the lowest moisture content is significantly different with To, T1, T2, T3. Numerically feeding 25% MOLM can give acceptable carcass yield moisture of 67.88% in thigh, while 74.79% in breast. Interestingly, 75 to 100% MOLM substitution reduced the moisture in the breast and thigh by 1.43% and 12.95%, respectively.

Similarly, no significant differences is observed in the crude proteins of breasts meat of pekin duck fed with 25% to 100% MOLM as protein source with pekin ducks fed with 100% SOM as protein source in breast pekin ducks. But in crude protein analysis of thigh meat, significant results were obtained. T4 which has the lowest crude protein content among treatments is significantly different with To, T1, T2, and T3. However, the same trend of data is observed i.e., as the percentage of MOLM substitution increases, the crude protein content decreases. An increase of 75% to 100% MOLM yielded to 9.30% reduction in crude protein in breast while 9.40% reduction in crude protein in thigh. This observation is true to both breast and thigh of the pekin ducks fed with MOLM.

The analyzed crude fat from the meat of Pekin ducks fed with 25% to 100% MOLM as protein source again gave the same comparable results with pekin ducks fed with 100% SOM as PS in both breast and thigh of pekin ducks. An increase of 50% to 75% MOLM reduces the crude fat to 33.26 in breast and 64% in thigh.

The observations from this study had shown that substituting 25% *Moringa oleifera* leaf meal (MOLM) might be high enough, though have comparably improved moisture percentage, crude protein composition and fatty acid composition of the pekin duck meat. However, feeding pekin ducks with more than that of 25% or 50% MOLM as substitute noticeably tends to reduce the moisture percentage, crude protein and fatty acid contents of the pekin duck meat. This is may be due to the fact that, even though M. *oleifera* contains nutritional qualities, it is also interested to note that the plant also contains toxins that might give negative results.

The result of this study on carcass quality is in consonance with the findings of Safa MA El Tazi (2014) who reported that, chicks fed on *Moringa oleifera* with 7% MOLM based diets produced significantly higher breast and drumstick percentages as compared to control group. He concluded that, feeding *M. oleifera* leaf meal at 0.2, 0.4 and 0.6 levels had no negative influence on carcass quality but rather improved the breast and drumstick of broiler chicks. The results also corroborate with the statements of Makkar and Becker (1997), that M. *oleifera* Lam leaves are rich in carotenoids, ascorbic acid and iron. The leaves are widely recognized as a food source for humans and a dry season feed for animals because of the nutrient contents it contains.

In addition, aanalysis on fat and water soluble vitamins indicated that *Moringa* is rich in vitamins and their precursors. Results of this study agreed with those of past workers (Atawodi, S.E., Atawodi, J.C., Idakwo, G.A., (2010) and Anjorin *et al*., 2010) who noted high concentrations of vitamins in *Moringa oleifera* products. Donovan (2007) noted that *Moringa oleifera* provides twice, the vitamin A in carrots and seven times, the ascorbic acid in citrus. Analyses of some macro- and micro-minerals revealed the plants to be high in concentration of phosphorus (1600 ppm), potassium (9615 ppm), sodium (9240 ppm), calcium (2925 ppm), magnesium (2998 ppm) and zinc (41 ppm), copper (28.25 ppm), manganese (125 ppm), respectively.

Data obtained on mineral composition of *Moringa* in this analysis confirmed reports of early works (Fahey, 2005; Donovan, 2007) that *Moringa* products contain 9-times the iron in spinach, 14-times the calcium in milk and 4-times the potassium in bananas and plantains warranting the tree crop products as healthy food/feedstuff sources. But equally important is the fact that some parts of the tree contain toxins and other anti-nutritional factors that might decrease its potential as a source of food for animals or humans.

For instance its bark contains tannins, alkaloids, saponnins and inhibitors (Makkar *et al*., 1990). The results of the study can be explained by the reasons that although, *Moringa* products have been demonstrated to contain numerous valuable nutrients and to be potential sources of cheap carbohydrate, protein, vitamins, lipids, essential minerals, the presence of the toxic chemicals could cause constraints to the enhanced utilization of the seeds in nutrition of man and animal as exemplified in decreasing weight gain or growth rate with increasing intake observed in this study. This claim may be true since Kieg and Fox (1978) reported that toxicants like phenols including tannins and many others can bind or enzymatically destroy particular nutrients present in feeds thereby decreasing availability and utilization, thus are no longer used by the animals.

The general observation on decreasing the moisture, crude protein and crude fat analyses while increasing the MOLM contents may be due to the negative effect of the anti-nutritional factors present in MOLM on pekin ducks. *M. olefeira* contains 1-23g of tannin in every 1 kg of leaves (Kakengi *et al*., 2003). Tannin has been reported to interfere with the biological utilization of protein and to a less extent available carbohydrate and lipids (Esonu, 2001).

The reducing moisture percentage, crude protein and fat analysis may be explained by evidence abound in literature on the effects of *Moringa* phytochemicals that when consumed in high doses could prove or may be fatal, hence further research must be carried out to ascertain the toxicity of the materials applied in this study.

Table 2. Moisture (%), Crude Protein % and Crude Fat Analyses of Breast and Thigh of Pekin Ducks Fed with Different Levels of M. *oleifera* Leaf Meal (MOLM) as Protein Source (2016).

Treatment	Breast			Thigh		
	Moisture	Crude protein	Crude fat analysis	Moisture	Crude protein	Crude fat analysis
100% SOM	75.64	21.13	2.71	69.67a	19.64a	6.15
25% MOLM	74.06	19.54	4.51	70.36a	19.18ab	6.18
50% MOLM	74.95	19.58	4.90	69.03a	19.90a	5.54
75% MOLM	74.71	20.09	3.27	68.69a	18.75ab	5.02
100% MOLM	74.57	18.21	3.86	61.68b	17.40b	5.49
Cv	*4.44*	*7.10*	*53.73*	*4.91*	*6.32*	*28.29*
Statistical inference	ns	ns	ns	*	*	ns

ns- not significant at 5% level of significance.

* = significant at 5% level

Note: Means with common letters are not significantly different with each other using LSD

Conclusion and recommendation

Based from the results of the study on the effect of different levels of MOLM as SOM substitute in Pekin Duck under orchard farming system, it is therefore concluded that that full replacement of MOLM to SOM has no significant effect on the growth and carcass yield parameters of pekin duck.

Hence, the carcass quality of pekin ducks fed with different levels of *Moringa oleifera* leaf meal as supplements, i.e., from 25%- 100% substitution of MOLM did not differ significantly in terms of moisture percentage, crude protein(%) and crude fat analysis (%) in both thigh and breast. It is also recommended that a similar study be conducted substituting fishmeal with different levels of MOLM as protein source in the diet of pekin duck and also to broiler and laying chickens. Likewise, a study on the anthelmintic property of moringa on poultry is also recommended.

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